ALKOR – 378

Cruise Report / Fahrtbericht

Morphodynamik in der Deutschen Bucht, Teilprojekt Bodenmodell – Sediment

22.07. – 07.08.2011

Institut für Geowissenschaften
Sedimentologie, Küsten- und Schelfgeologie

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Objective of the cruise AL - 378

The cruise AL – 378 was carried out in the frame of the BMBF funded project AufMod (Aufbau von integrierten Modellsystemen für die Deutsche Bucht). The objective was to collect high resolution data of bathymetry, geological built up of the seafloor and physical properties of seabottom sediments in the area west of Sylt Island (North Sea). Use of this knowledge will strongly improve the application of numerical models to predict large scale and long term morphodynamics of the North Sea.

Abbrevations used in this report:

C3D - Side-Scan Sonar (towed)	**SSS**
C3D - Subbottom Profiler (towed)	**SBP**
Multibeam Echosounder (Moon Pool)	**MB**
Innomar Subbottom Profiler (hull mounted)	**SES**
Boomer Subbottom Profiler (towed)	**BSP**
Sediment classification System – Roxanne (Moon Pool)	**SCS**
Grab Sampler	**GS**
Vibrocore	**VC**
Underwater Video	**UWV**
CTD	**CTD**

Participants of ALKOR – 378 (AufMod)

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CRUISE NARRATIVE

Fr. 22.07.2011 Storm, departure shifted to Sunday, 24.07.2011
Su. 24.07.2011 Storm, departure shifted to Monday, 25.07.2011

Mo. 25.07.2011
Weather: SW 5-6, cloudy,
13:15 Departure, transit through Kiel Canal, heading for working area, Late departure due to some technical problems with FS ALKOR

Di. 26.07.2011
Weather: E, 1 – 2, sunny
06:30 CTD-profile
07:00 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), profiling
19:00-00:00 BSP out of water
During the night hydroacoustic profiling with SSS, SES, MB and SCS

We. 27.07.2011
Weather: E, 1 – 2, sunny
00:00 - 06:00 CTD Profil,
06:30 Deployment of BSP, continuation with hydroacoustic profiling
20:00 BSP out of water
20:00 – 00:00 During the night profiling with SSS, SES, MB and SCS

Th. 28.07.2011
Weather: NW 3, cloudy
00:00 - 06:45 Profiling with SSS, SES, MB and SCS
06:45 SSS out of water
07:00 CTD profile
09:30 VC station 1 (core 1, SES station 7)
10:30 VC station 2 (core 2, SES station 1)
11:45 – 18:30 GS (AL-378-280711-**01** - AL-378-280711-**21**)
18:50 – 00:00 Deployment of SSS, SBP; during the night hydroacoustic profiling (SSS, SES, MB and SCS

Fr. 29.07.2011
Weather: NW 5, Squalls 6
00:00 – 10:00 Profiling with SSS, SES, MB and SCS
10:25 VC station 3 (core 1, SES station 7)
11:33 VC station 4 (core 2, SES station 1), no penetration
12:23 Deployment of SSS, SBP; during the night hydroacoustic profiling (SSS, SES, MB and SCS)

Sa. 30.07.2011

Wetter; cloudy, NW 6, Squalls 7

09:30 End of profiling, systems out of water, transit to Helgoland

14:30 Arrival Helgoland

Su. 31.07.2011

Weather: cloudy, NW 4 – 5, decreasing 3

07:00 Departing Helgoland, heading for working area

08:30 CTD

08:40 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), problems with MB (did not start)

18:00 SBP out of water

18:15 – 00:00 Continuation of profiling

Mo. 01.08.2011

Wetter: cloudy, SE 0 -2

00:00 – 06:40 Hydroacoustic profiling

06:50 - 07:00 CTD

08:00 VC station 5

08:40 VC station 6

10:10 Start underwater video profile

11:20 End underwater video profile

12:00 VC station 7

12:35 VC station 8a, no penetration

13:00 VC station 8b

14:30 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), hydroacoustic profiling

20:00 SB out of water

20:00 – 00:00 Continuation of hydroacoustic profiling

Tu. 02.08.2011

Weather: SE 0 – 2, partly sunny

0:00 – 04:00 SB deployed

07:00 end of profiling

08:00 VC station 9

08:55 VC station 10

10:00 – 13:30 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), hydroacoustic profiling

14:00 VC station 11 (Banana)

15:00 VC station 12

16:00 – 16:15 CTD

16:20 – 00:00 Deployment of devices, profiling (SSS, SES, SBP, BSP, MB und SCS)

22:00 SBP out of water

We. 03.08.2011

Weather: ESE 4 – 5, cloudy.

03:30 Problems with MB (could not be solved),

08:00 Devices out of water

08:15 – 08:25 CTD

08:40 VC station 13

09:30 VC station 14

11:20 – 00:00 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), hydroacoustic profiling

Th. 04.08.2011

Wetter: cloudy, rainy, SE 3 – 4

00:00 – 09:00 end of profile, devices out of water

10:00 VC station 15, 2 trials, no penetration

10:50 – 15:00 Deployment of devices (SSS, SES, SBP, BSP, MB und SCS), hydroacoustic profiling

15:00 End of profile, devices out of water

15:40 – 16:44 VC station 16, 4 trials, no penetration

18:20 – 00:00 Deployment of devices (SSS, SES, SBP, MB und SCS), profiling

Fr. 05.08.2011

Weather: rainy, SW 7, squalls 8

06:00 End of profiling, devices out of water

07:00 – 18:40 Grab sampling

18:50 – 00:00 Profiling with SSS, MB, SES

Sa. 06.08.2011

Weather: NW 2

04:00 Deployment of Boomer

13:50 End of profiling, devices out of water

14:20 – 14:30 CTD

15:40 – 16:30 SSS profile

16:40 Heading back to Kiel

Su., 07.08.2011

13:00 Arrival Kiel, IFM pier

Tab. 1: Hydroacoustic profiling

No.	Date	Time	Lat	Long	Remarks
01	26.07.2011	05:12:32	54° 54.894'	007° 57.763'	begin
01	26.07.2011	08:26:05	55° 06.966'	007° 57.491'	end
02	26.07.2011	08:26:46	55° 06.960'	007° 57.018'	begin
02	26.07.2011	15:37:04	54° 41.388'	007° 57.705'	end
03	26.07.2011	15:47:11	54° 41.370'	007° 57.471'	begin
03	26.07.2011	21:51:14	55° 06.846'	007° 56.684'	end
04	26.07.2011	22:01:20	55° 06.846'	007° 56.648'	begin
04	27.07.2011	03:40:49	54° 43.494'	007° 56.970'	end
05	27.07.2011	06:21:07	54° 37.590'	007° 55.984'	begin
05	27.07.2011	12:02:49	55° 03.138'	007° 55.342'	end
06	27.07.2011	12:06:17	55° 03.138'	007° 55.154'	begin
06	27.07.2011	18:00:11	54° 37.596'	007° 55.826'	end
07	27.07.2011	18:32:15	54° 37.590'	007° 55.654'	begin
07	27.07.2011	23:28:32	55° 03.138'	007° 55.010'	end
08	27.07.2011	23:32:04	55° 03.138'	007° 54.823'	begin
08	28.07.2011	04:31:15	54° 37.590'	007° 55.496'	end
09	28.07.2011	19:02:12	54° 37.578'	007° 55.337'	begin
09	29.07.2011	00:01:00	55° 03.144'	007° 54.670'	end
10	29.07.2011	00:03:10	55° 03.150'	007° 54.504'	begin
10	29.07.2011	05:15:26	54° 37.584'	007° 55.169'	end
11	29.07.2011	05:40:38	54° 37.578'	007° 55.001'	begin
11	29.07.2011	14:21:30	55° 03.150'	007° 54.346'	end
12	29.07.2011	14:24:42	55° 03.144'	007° 54.161'	begin
12	29.07.2011	20:20:10	54° 37.578'	007° 54.814'	end
13	29.07.2011	20:50:47	54° 37.584'	007° 54.644'	begin
13	30.07.2011	03:46:51	55° 03.156'	007° 53.999'	end
14	30.07.2011	03:50:07	55° 03.156'	007° 53.763'	begin
14	30.07.2011	09:20:32	54° 37.578'	007° 54.506'	end
15	31.07.2011	09:18:08	54° 37.572'	007° 54.313'	begin
15	31.07.2011	16:04:34	55° 03.156'	007° 53.669'	end
16	31.07.2011	16:16:57	55° 03.180'	007° 53.458'	begin
16	31.07.2011	21:54:26	54° 37.572'	007° 54.151'	end
17	31.07.2011	22:16:46	54° 37.572'	007° 53.986'	begin
17	01.08.2011	03:53:16	55° 03.180'	007° 53.324'	end
18	01.08.2011	03:59:25	55° 03.174'	007° 53.114'	begin
18	01.08.2011	17:54:09	54° 37.566'	007° 53.827'	end
19	01.08.2011	18:21:29	54° 37.572'	007° 53.647'	begin
19	02.08.2011	00:17:59	55° 03.120'	007° 52.981'	end
20	02.08.2011	00:21:23	55° 03.132'	007° 52.830'	begin

No.	Date	Time	Lat	Long	Remarks
20	02.08.2011	05:54:21	54° 37.566'	007° 53.489'	end
21	02.08.2011	06:22:16	54° 37.566'	007° 53.312'	begin
21	02.08.2011	18:15:15	55° 03.204'	007° 52.624'	end
22	02.08.2011	18:20:48	55° 03.210'	007° 52.434'	begin
22	02.08.2011	23:29:27	54° 37.566'	007° 53.152'	end
23	02.08.2011	23:49:28	54° 37.566'	007° 52.981'	begin
23	03.08.2011	05:57:19	55° 03.246'	007° 52.298'	end
24	03.08.2011	06:03:10	55° 03.228'	007° 52.057'	begin
24	04.08.2011	13:22:29	54° 37.560'	007° 52.811'	end
25	04.08.2011	13:47:10	54° 37.560'	007° 52.646'	begin
25	04.08.2011	23:06:12	55° 03.090'	007° 51.965'	end
26	04.08.2011	23:09:14	55° 03.084'	007° 51.805'	begin
26	05.08.2011	04:28:27	54° 37.566'	007° 52.480'	end
27	05.08.2011	04:49:06	54° 37.560'	007° 52.315'	begin
27	05.08.2011	06:01:56	54° 43.074'	007° 52.173'	end
28	03.08.2011	11:21:18	54° 44.574'	007° 57.733'	begin
28	03.08.2011	12:20:43	54° 49.518'	007° 57.551'	end
29	03.08.2011	12:23:48	54° 49.536'	007° 57.755'	begin
29	03.08.2011	13:24:44	54° 44.550'	007° 57.893'	end
30	03.08.2011	13:27:36	54° 44.544'	007° 58.067'	begin
30	03.08.2011	14:27:23	54° 49.566'	007° 57.869'	end
31	03.08.2011	14:32:00	54° 49.584'	007° 58.085'	begin
31	03.08.2011	15:32:37	54° 44.562'	007° 58.230'	end
32	03.08.2011	15:35:01	54° 44.538'	007° 58.407'	begin
32	03.08.2011	16:36:45	54° 49.602'	007° 58.211'	end
33	03.08.2011	16:42:04	54° 49.554'	007° 58.415'	begin
33	03.08.2011	17:42:20	54° 44.532'	007° 58.465'	end
34	03.08.2011	17:45:33	54° 44.514'	007° 58.715'	begin
34	03.08.2011	18:50:33	54° 49.602'	007° 58.584'	end
35	03.08.2011	19:08:16	54° 49.512'	007° 58.741'	begin
35	03.08.2011	20:10:12	54° 44.490'	007° 58.909'	end
36	03.08.2011	20:14:04	54° 44.484'	007° 59.028'	begin
36	03.08.2011	21:32:38	54° 49.632'	007° 58.922'	end
37	03.08.2011	21:35:41	54° 49.632'	007° 59.074'	begin
37	03.08.2011	22:36:25	54° 44.514'	007° 59.241'	end
38	03.08.2011	22:39:52	54° 44.490'	007° 59.397'	begin
38	03.08.2011	23:40:51	54° 49.560'	007° 59.267'	end
39	03.08.2011	23:43:13	54° 49.554'	007° 59.452'	begin
39	04.08.2011	00:43:03	54° 44.520'	007° 59.574'	end
40	04.08.2011	00:45:48	54° 44.514'	007° 59.739'	begin
40	04.08.2011	01:05:20	54° 49.536'	007° 59.603'	end

No.	Date	Time	Lat	Long	Remarks
41	04.08.2011	01:48:29	54° 49.554'	007° 59.779'	begin
41	04.08.2011	02:49:22	54° 44.568'	007° 59.912'	end
42	04.08.2011	02:51:41	54° 44.556'	008° 00.107'	begin
42	04.08.2011	03:51:58	54° 49.567'	007° 59.945'	end
43	04.08.2011	04:00:38	54° 49.566'	008° 00.097'	begin
43	04.08.2011	05:02:14	54° 44.652'	008° 00.246'	end
44	05.08.2011	18:52:58	55° 03.078'	007° 53.186'	begin
44	05.08.2011	22:22:40	54° 57.018'	007° 32.098'	end
45	05.08.2011	23:22:48	54° 57.000'	007° 24.083'	begin
45	06.08.2011	04:38:46	54° 57.006'	008° 10.138'	end
46	06.08.2011	04:43:22	54° 56.826'	008° 10.120'	begin
46	06.08.2011	13:47:46	54° 56.778'	007° 10.067'	end

Tab. 2: Stations Grab Sampling

No	Lat	Long	Date	Time UTC)	Waterdepth	Remarks
01	7'55.030	55'02.887	28.07.11	11:50	18,41	
02	7'55.362	55'00.886	28.07.11	12:19	17,20	
03	7'55.931	55'00.621	28.07.11	12:33	17.34	
04	7'55.303	55'00.146	28.07.11	12:52	16.74	
05	7'55.179	54'58.135	28.07.11	13:16	17.49	
06	7'54.910	54'57.905	28.07.11	13:26	16.54	
07	7'55.187	54'57.686	28.07.11	13:37	17.02	
08	7'55.187	54'57.327	28.07.11	13:48	16.30	
09	7'55.730	54'56.889	28.07.11	14:00	17.00	
10	7'55.299	54'55.021	28.07.11	14:22	17.44	
11	7'55.300	54'46.327	28.07.11	15:36	17.02	
12	7'55.620	54'54.957	28.07.11	15:51	16.29	
13	7'55.618	54'45.901	28.07.11	15:58	16.50	
14	7'55.475	54'45.265	28.07.11	16:11	15.87	
15	7'55.545	54'45.063	28.07.11	16:21	15.55	
16	7'55.670	54'42.371	28.07.11	16:48	14.63	
17	7'55.610	54'41.517	28.07.11	17:01	14.67	
18	7'55.578	54'41.215	28.07.11	17:19	13.78	
18b	7'55.578	54'41.215	28.07.11	17:21	14.21	
19	7'55.528	54'38.344	28.07.11	17:51	12.60	
20	7'55.621	54'37.404	28.07.11	18:19	12.00	
21	7'55.718	54'36.849	28.07.11	18:32	11:00	
22	7'52.810	54'37.256	05.08.11	07:09	15.51	
23	7'53.527	54'38.200	05.08.11	07:35	14.21	

24	7'53.479	54'38.274	05.08.11	07:45	13.60	
25	7'53.679	54'39.543	05.08.11	08:09	13.60	
26	7'54.011	54'40.319	05.08.11	08:30	14.50	
27	7'54.511	54'41.915	05.08.11	08:58	14.28	
28	7'53.488	54'43.019	05.08.11	09:25	14.03	
29	7'52.747	54'44.519	05.08.11	09:49	15.54	Empty, second trial
				09:51	15.16	
30	7'53.580	54'45.379	05.08.11	10:14	15.57	
31	7'59.011	54'45.045	05.08.11	10:54	14.43	Empty, second trial
	7'59.029	54'45.059			14.43	
32	7'59.472	54'45.064	05.08.11	11:09	14.74	
33	7'59.903	54'46.611	05.08.11	11:35	14.54	
34	7'58.537	54'47.414	05.08.11	12:01	15.41	
35	7'57.923	54'48.378	05.08.11	12:18	17.36	
36	7'54.236	54'48.356	05.08.11	12:46	18.95	
37	7'53.725	54'49.513	05.08.11	13:05	19.18	
38	7'53.766	54'51.052	05.08.11	13:26	18.43	
39	7'54.174	54'52.339	05.08.11	13:46	18.97	
40	7'52.793	54'53.215	05.08.11	14:07	19.36	
41	7'53.082	54'54.097	05.08.11	14:25	19.97	
42	7'53.328	54'55.238	05.08.11	14:43	18.99	
43	7'52.873	54'55.660	05.08.11	14:55	20.81	
44	7'52.706	54'56.314	05.08.11	15:07	19.16	
45	7'54.737	54'57.152	05.08.11	15:32	17.64	Stone
	7'54.794	54'57.176		15:37	18.38	Not enough sediment
	7'54.743	54'57.167		15:43	18.48	
46	7'52.795	54'57.124	05.08.11	16:00	19.47	
47	7'52.678	54'57.655	05.08.11	16:13	19.62	
48	7'53.545	54'58.105	05.08.11	16:28	19.18	
49	7'52.604	54'58.666	05.08.11	16:44	19.57	
50	7'52.487	54'58.883	05.08.11	16:53	18.14	
51	7'52.701	54'59.833	05.08.11	17:08	17.92	
52	7'52.742	55'00.075	05.08.11	17:16	16.77	
53	7'53.629	55'00.774	05.08.11	17:31	18.73	
54	7'52.717	55'01.591	05.08.11	17:46	18.51	Not enough sediment
	7'52.746	55'01.592		17:48	18.58	
55	7'52.771	55'01.953	05.08.11	18:04	17.48	
56	7'53.239	55'02.815	05.08.11	18:19	17.90	
57	7'53.444	55'03.120	05.08.11	18:38	18.96	

Tab. 3: Stations Vibrocoring

Latitude	Long	Lat.	Waterdepth	Penetration	Corerecovery	Date	Time
K1	7°56,329	54°54.926	20	1,65	0,96	28.07.2011	09:34
K2	7°57,790	54°55.346	18,04	3	2,34	28.07.2011	10:25
K3	7°56,534	54°57.605	17,45	0,6	0,44	29.07.2011	11:03
K4 – failure	7°56,527	54°57.654	18,23			29.07.2011	11:33
5b	7°54,504	54°50.654	17,77			01.08.2011	08:06
K6	7°55,173	54°50.582	18,02		2.21	01.08.2011	08:41
K7	7°55,249	54°41.097	15,92	1,65	0,79	01.08.2011	12:00
Kb8	7°55,024	54°42.945	16,42	2,05	1,01	01.08.2011	13:00
K9	7°55,103	54°42.878	14,38	2,15	1,13	02.08.2011	08:09
K10	7°55,924	54°41.374	14,36	2,15	1,46	02.08.2011	08:55
K11	7°54,898	54°56.898	18,21	2,05		02.08.2011	13:57
K12	7°54,493	54°57.283	17,8	1,6	1,48	02.08.2011	15:05
K13	7°53,117	54°54.884	17,79	3	1,87	03.08.2011	08:43
K14	7°54,006	54°56.144	16,92	1,15	0,88	03.08.2011	09:24
K15	7°55,627	54°45.920	16,8	1,45		04.08.2011	09:55
K16	7°55,621	54°45.960	16,9	1,9		04.08.2011	10:26
K17	7°52,913	54°40.514	15,7	1,95	1,31	04.08.2011	15:42
K18a	7°52,929	54°39.898	14,6	0,7		04.08.2011	16:12
K18b	7°52,926	54°39.894	14,6	1,45		04.08.2011	16:29
K18c	7°52,923	54°38.899	14,6	1,05		04.08.2011	16:46

Tab. 4: CTD stations

No	Date	Time (UTC)	Lat	Long	Waterdepth
1	26.07.11	04:19	54°54.76	07°57.74	19.2
2	27.07.11	04:08	54°41.88	07°56.83	14.9
3	28.07.11	04:46	54°36.82	07°55.35	11.6
4	31.07.11	08:25	54°35.67	07°54.68	13.9
5	01.08.11	06:50	54°50.58	07°53.39	17.3
6	02.08.11	16:03	54°56.20	07°52.84	18.8
7	03.08.11	08:13	54°55.08	07°52.31	18.2
8	06.08.11	14:17	54°56.76	07°09.37	28.7

Tab. 5: Video profiles

No	Date	Time (UTC)	Lat	Long	Waterdepth	Action
1	01.08.11	10:12	54°41.21	07°55.60	15.5	Start profile
	01.08.11	11:17	54°41.69	07°55.56	17.7	End profile

Methods

The side scan sonar system **Benthos C3D** was applied to elaborate a comprehensive, high resolution map of seafloor sediment backscatter characteristics and sediment distribution patterns. The system operates in the chirp mode with a prequency of 200 kHz. The C3D was towed behind the vessel running with a speed of about 4 – 5 knots. A range of 100 m on each side was applied. This sidescan sonar system has a subbottom profiler included.

With the sediment classification system **ROXANNE** the seafloor could be classified according to its backscatter properties.

Different high resolution sub bottom profiler systems (**ED&G Boomer** system, **SES INNOMAR** System, hull mounted on ALKOR) were used to acquire high resolution data of the geological architecture, the sedimentological built up of the seafloor and the physical properties of seabottom sediments. These subbottom profiling systems are operating with different frequencies and therefore show differences regarding penetration and resolution.

Multibeam data were collected with the **SeaBeam 1185** (L3-Communications, ELAC Nautik GmbH), which operates with a sonar frequency of 180 kHz. The system collects bathymetric and sidescan data simutaneously with a swath width of 153.5°. The system was deployed in the moon pool of ALKOR. The data were acquired using the software Hydrostar (L3-Communications, ELAC Nautik GmbH).

Ground truthing was done by **grab sampling**, gravity coring with a **VK 300** and under water video observations.

By applying all these methods a much more detailed picture of sea bottom properties could be elaborated which allows new interpretations regarding the parameters controlling morpho- and sediment dynamics. Figure 1 shows the tracklines of all hydroacoustic profiles and the position of grab sampling stations, vibro cores and video profiles (Tab. 1 – 5) which we run and taken during cruise AL - 378.

Preliminary scientific results

Sediment sampling was done based on the sidescan sonar mosaic (see fig. 2). This mosaic (Fig. 2) shows a pattern of WNW – ESE striking areas of different sediment properties which indicate an alteration of fine grained and coarse grained sediment. Figure 3 shows in some more detail the alteration of high- (dark colours) and low backscatter (light colours) of the seafloor sediment. The red rectangle indicates an area where the high backscatter is not induced by coarse grained sediment, with is responsible for a rough sediment-surface, but by a very dense population of the benthic organism *Lanice conchilega*. These areas could be identified as well with the sediment classification system ROXANNE. The classification by ROXANNE was “rough” combined with “soft”. In Figure 3 the grab sample AL-378-280811-018 is shown. The whole sediment surface is densely populated by *Lanice conchilega*. Screen shots from the video profiles taken in this area are shown in Figure 4 (lower part of the figure, upper row). Grain size distributions from areas which are covered with different densities of *Lanice conchilega* and from areas where no *Lanice conchilega were observed are* shown in figure 5. There is no big difference in the sediment grain size distribu-

tion, which indicates that the differences in backscatter strength of the sidescan sonar signal are induced by the benthic organism.

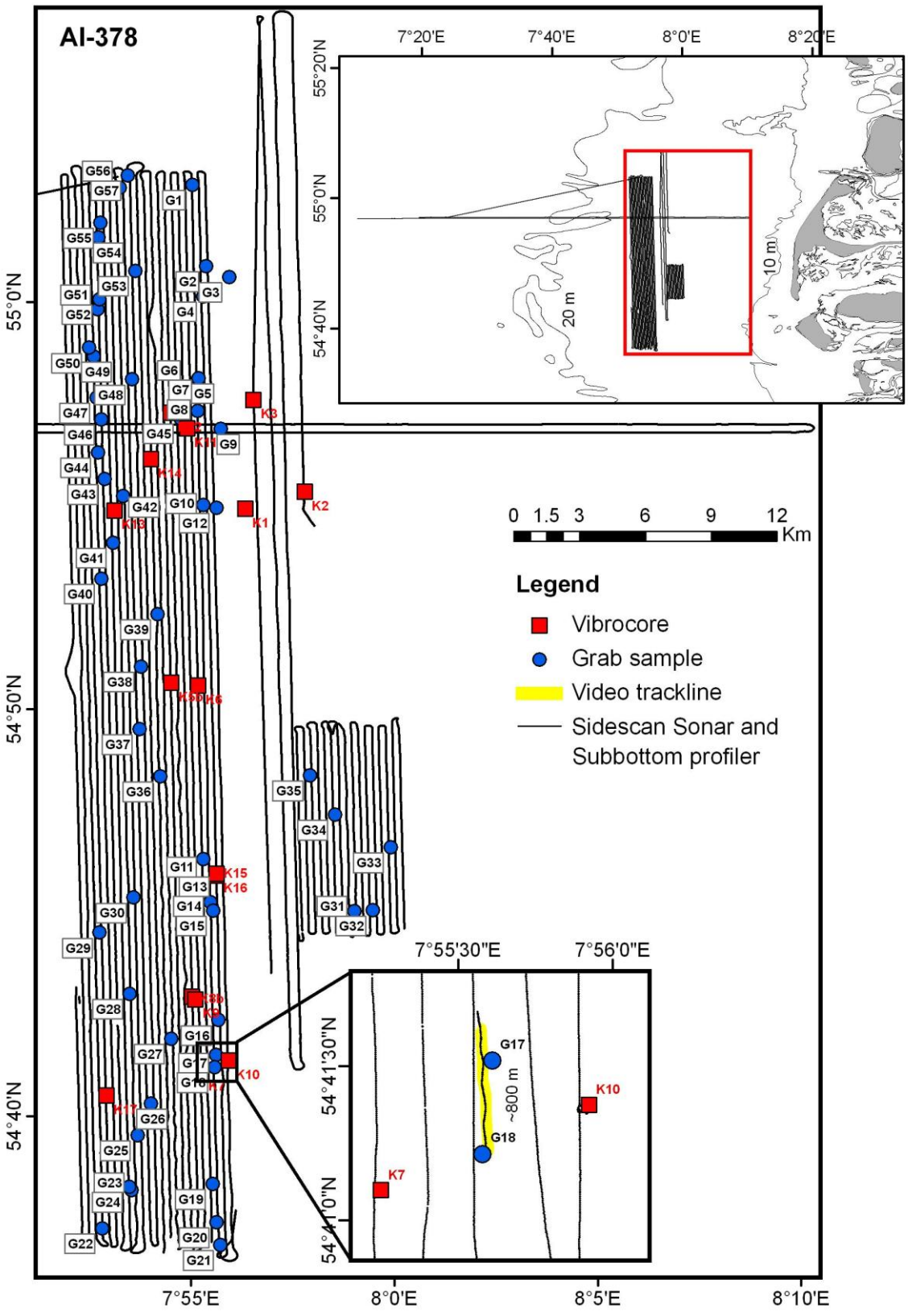

Fig. 1: Tracklines; positions of sampling and coring stations, video profile.

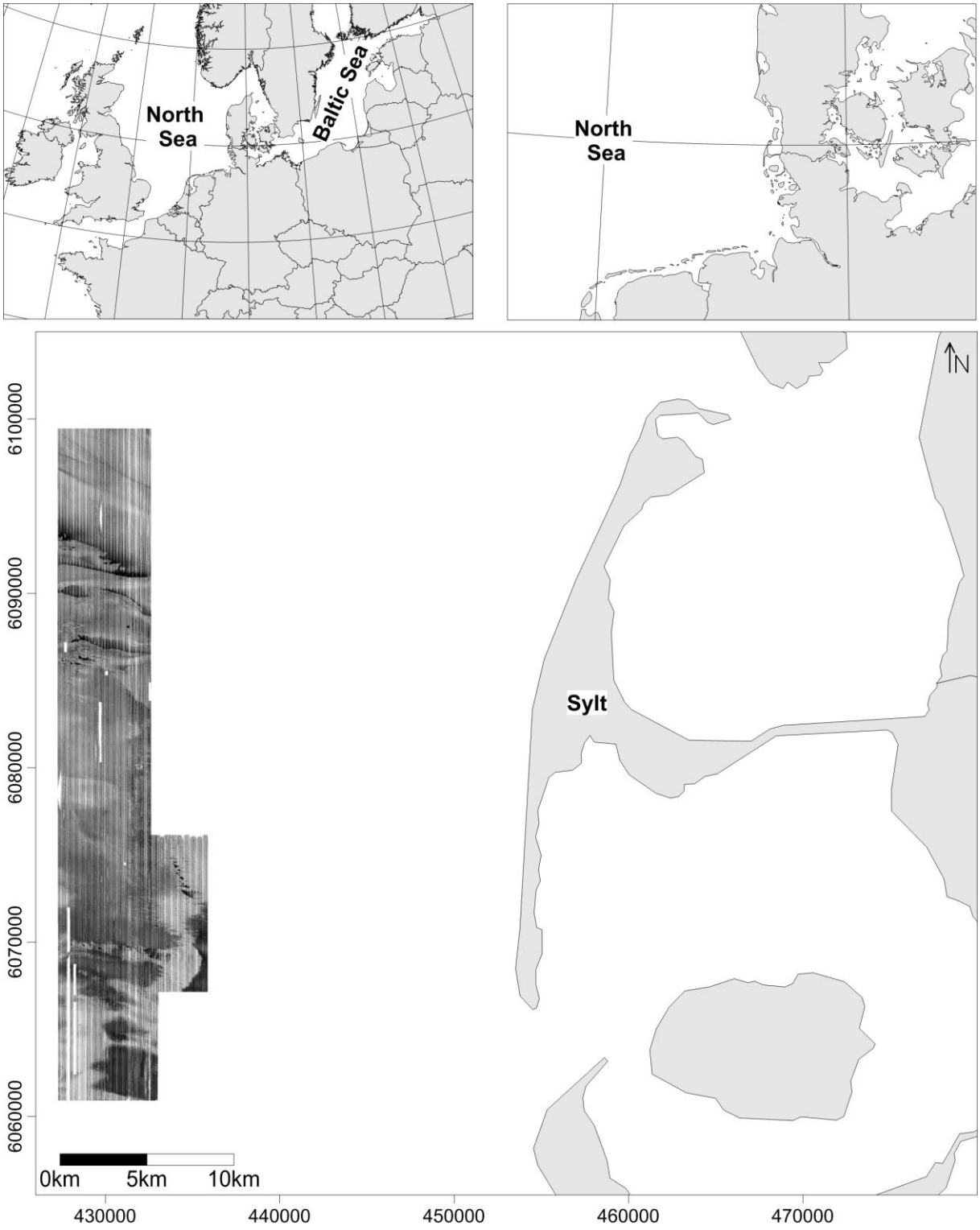

Fig. 2: Side-scan sonar mosaic of the surveyed area

Some other areas which as well show a small scale alteration of light and dark areas of backscatter signals could be identified as so called “sorted bedforms” (see e.g. Figure 3, the area above the red rectangle).

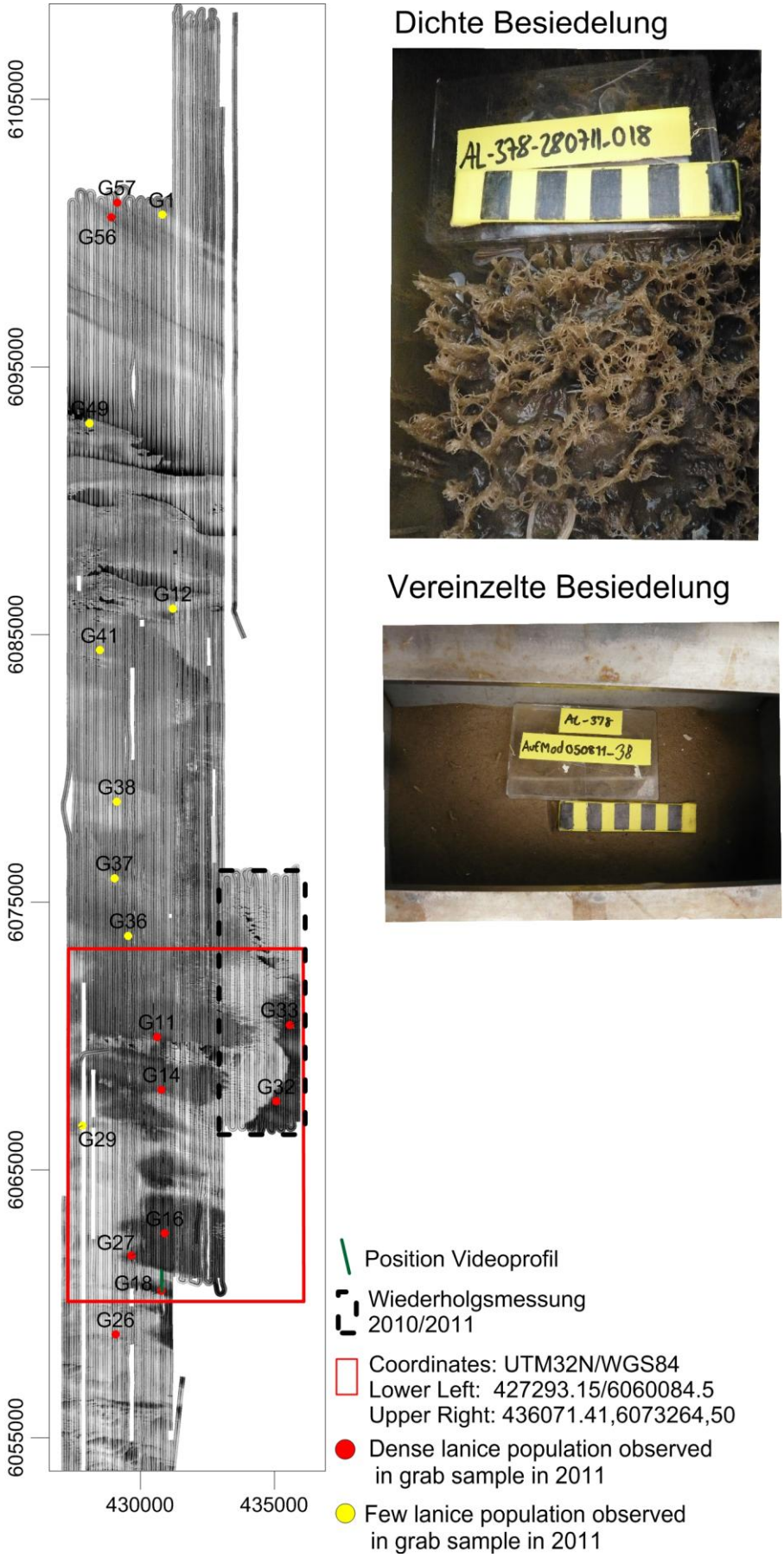

Fig. 3: Example of grab samples including the benthic organism *Lanice conchigela*

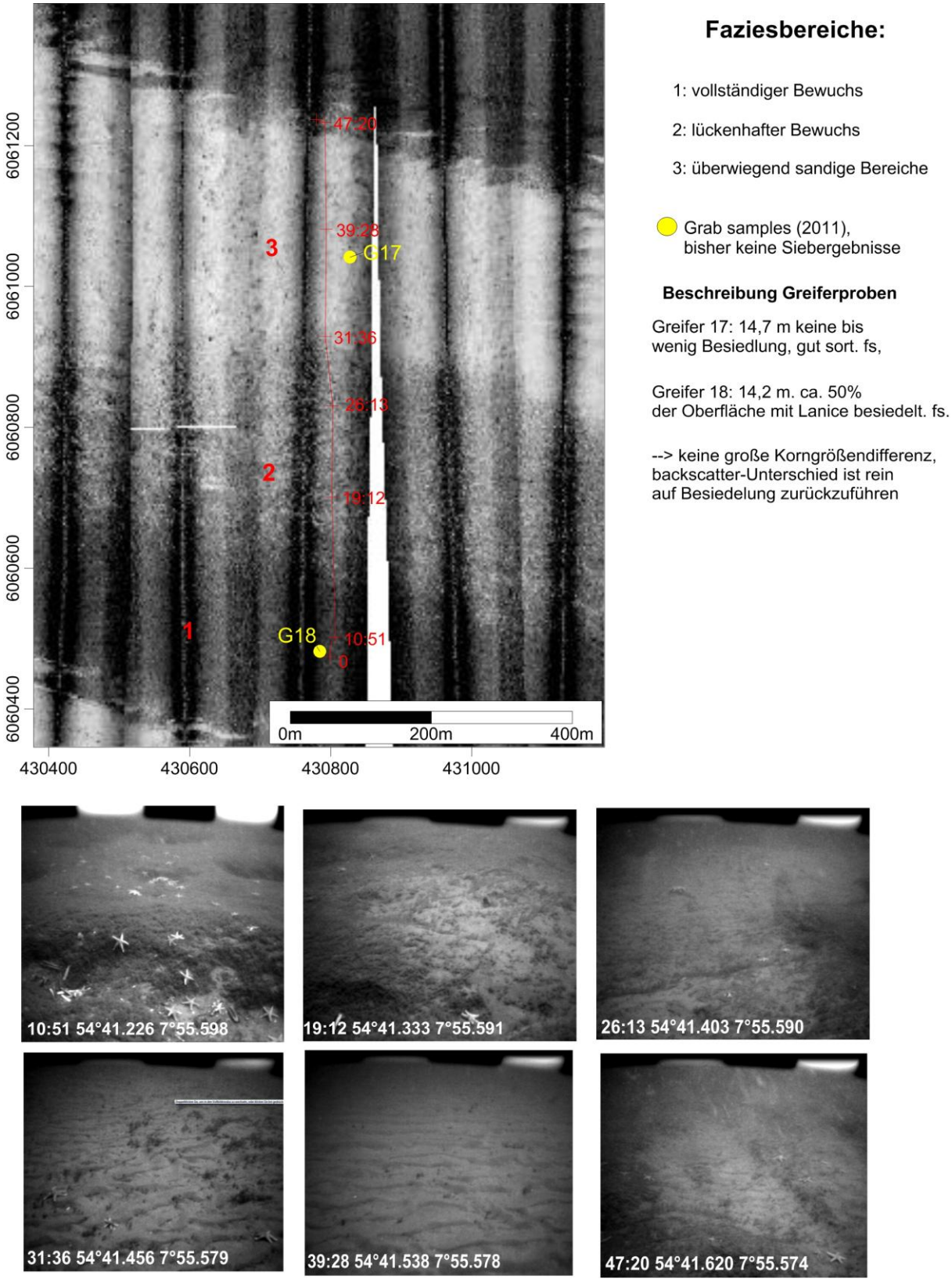

Fig. 4: Screenshots of the area which is densely populated by *Lanice conchigela*

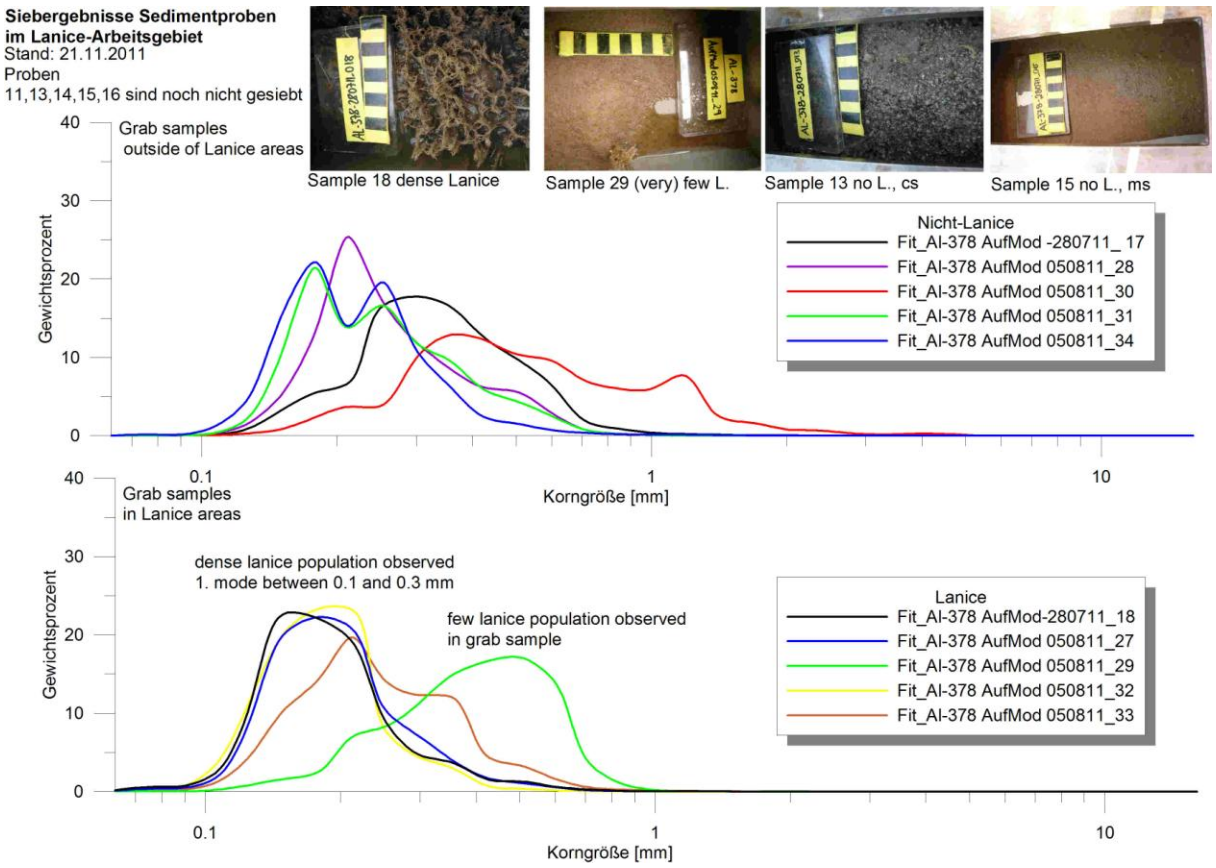

Fig. 5: Grain size distributions of grab samples

The architecture of the subsurface was investigated with 3 different sub bottom profiler systems. Figure 6 and 7 show some results of processed boomer data and SES data. In the boomer data (Fig. 6) an E – W extending channel system could be observed wet of Hörnum Deep. This channel system is cut into the subsurface down to 30 m below the seafloor. The infilling shows cut and fill structures, typical for wide tidal channels but as well for river systems. This channel system is covered by a 1 – 2 m thick layer of young Holocene deposits which could be penetrated with the vibro corer. 14C dating of organic material which was found in the sediment core material is in progress.

More detailed picture of the upper part of the subsurface is obtained from the SES INNOMAR data (Figure 7). A layer, approximately 1 m in thickness, is covering different kinds of sedimentary units. In figure 7 subparallel, angular bedded layers are covered by young Holocene deposits. These Holocene deposits could be penetrated several times with the vibrocorer which allows calibration of SES data with geological units. Analysis of core data is in progress.

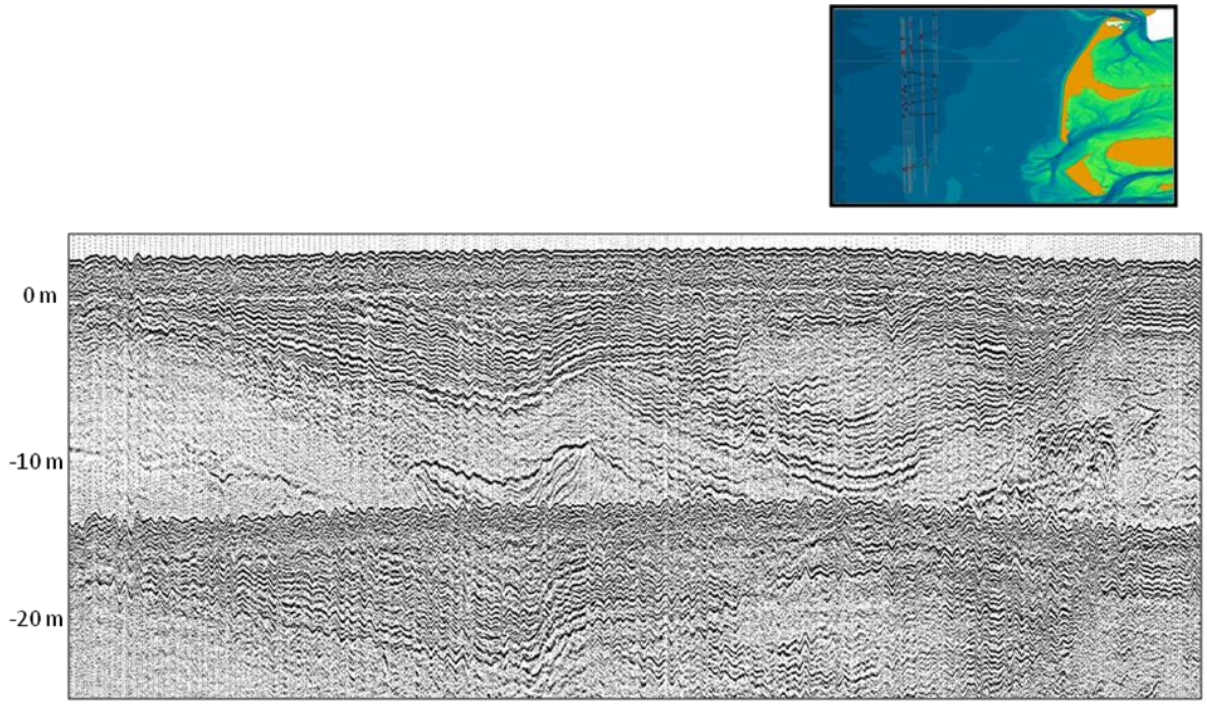

Fig. 6: Boomer record. Cut and fill structures with an incision depth of more than 25 m below the sea-floor west of the tidal channel “Hörnum Deep”.

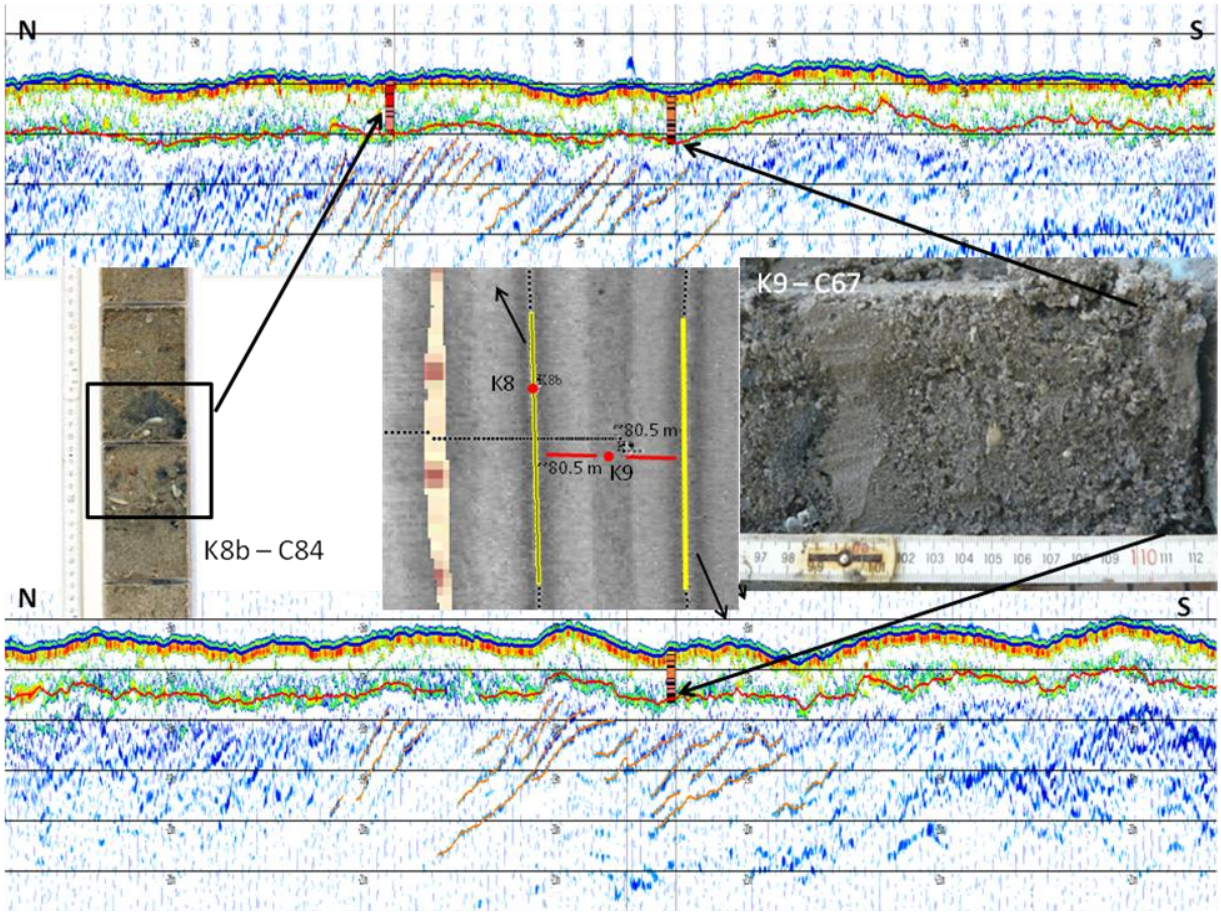

Fig. 7: Example of the correlation of stratigraphical units from SES profiles with layers in sediment cores.